but there is no thought that it should dominate the scene. From the standpoint of teaching, Florida will transfer the scientific approach to tropical agriculture through the production of students. However, in addition, the future should see a greater movement in both directions of faculty from one location to another. This kind of mix is highly important to prevent provincialism and the development of fixed ideas. In the United States the undesirability of inbred faculties has been brought out in numerable cases.

Theoretically, it does not appear wise for every political unit to maintain universities containing all of the professional degrees. It would appear much wiser to have the various universities specialize in certain professional fields and open their doors to students of other countries. However, when several universities in the United States tried to do this, failure resulted. State pride and provincialism defeated logic.

On the other hand, cooperative, regional research efforts have been quite successful and for the immediate future there is a pressing need to develop and activate this concept.

One of the great needs of the tropical fruit industries is the selection and development of commercial fruit varieties and rootstocks because the scion variety-rootstock combination is the keystone to success in any tree fruit enterprise. Research of this nature requires plant breeders and careful horticultural appraisal of varieties. It requires long-range planning and stability. It demands regulatory programs to maintain virus-free budwood and plant material that is validated as true to type and certified free of nematodes. Banks of plant material and cooperative variety and rootstock tests must be developed. It is imperative that representatives from each of the countries or areas producing tropical fruits develop a cooperative research project dealing with problems of variety improvement that will result in standardized variety and rootstock trials, the collection and evaluation of native species, the easy exchange of plant material and information and a program whereby the researchers involved can meet periodically to discuss results and plan for the future.

This is only one example of the kind of cooperative project that is needed. Projects on plant nutrition, the influence of climate and the soil environment on tropical crops, propagation procedures and, in fact, the entire spectrum of research so necessary for the development of prosperous fruit industries must be formed on an international, cooperative basis with a free interchange of personnel, equipment and knowledge. If Florida does not take the lead in this respect then it will forfeit its role to future greatness in the world of tropical horticulture.

**FINAL REPORT ON SOME MANGO HYBRIDS — 1969**

**DAVID STURROCK**

West Palm Beach

At the 1962 meeting of this Society I gave a progress report on some mango hybrids from the crop of 1956. It had been my hope to present a final report within three or four years but the numerous hurricanes of the early and mid 60's forced delay — the final checks were not made until this year. The results, although not very spectacular, hold interest from several points of view.

Having had several years experience in Cuba with the fibrous West Indian forms of the mango, and with the East Indian forms which suffered so much in that climate from Anthracnose, I was impressed with the clean appearance of the small, yellow skinned, highly productive 'Pico' form of Philippine mango. This fruit matured almost free from Anthracnose and was a general favorite in local markets. In view of this I was greatly interested in the suggestion of Peter J. Wester that crossing the high quality fiberless Philippine with the larger high colored East Indian forms it might be possible to produce fruits of superior quality of high productivity, and probably less prone to Anthracnose.

Edward Simmonds, for many years in charge of the Miami Station of the USDA Bureau of Foreign Seed and Plant Introduction, made several attempts to follow this suggestion. He crossed the Indian variety 'Paheri' with the Philippine 'Carabao' and produced the 'Edward'
variety. Other Hybrids were the Haden x Carabao 'Simmonds' and the Amini x Saigon 'Samini'. Each of these was an improvement pointing in the right direction but Edward Simmonds died before he could go further with the work.

In the belief that further work along this line of procedure would be beneficial attempts were made to do so by the writer during the blooming season of 1956. Singh in India, and Young and Ledin in Florida, proved the almost impossibility of successful hybridization by standard methods of hand pollination, the results were less than one half of one percent. In view of this situation, and as it was not possible to give the needful time each day for such operations, a short-cut method was tried hoping for the friendly cooperation of nature.

In a small planting of mango trees, planted casually among palmettos, there was some crowding of side branches. It was thought to fasten some of the branchlets so that the bloom spikes were closely intermingled to facilitate hybridization by visiting insects. While outside pollinization would be possible it was considered that cross-pollination would be highly probable. Later results proved this to be true.

The Edward variety, the best of the Simmonds hybrids, was chosen as the pistil parent in all instances. The Philippine 'Pico' was the preferred pollen parent but, in some instances where the situation made it possible, the Kent and Springfels varieties were also used as pollen parents. The Edward fruits were harvested, and marked with ink denoting probable pollinator. The seeds were hulled and planted in gallon cans, carrying tape with essential data. All seeds were monoembryonic. Several seedlings were discarded the first year due to susceptibility to scab. From the original 75 seedlings 56 were retained. At the age of 18 months these seedlings ranged in height from three to four feet. Of these 9 were Edward x Springfels; 10 were Edward x Kent, and 27 were Edward x Pico.

To reduce the time to fruiting the seedlings were inarched on branches of four year old trees. Inarching was used to avoid the loss of growth already attained by the seedlings. The cans were fastened to the branches with insulated wire. The graft cuts were made from four to six inches long, and were bound with rubber bands reinforced with horticultural tape for security. This work was done in early March of 1958, the plants being watered almost every day until late June when the graft unions were well set. In cutting off the branches of the stock trees a stub of about eight inches was left to afford a reinforcing tie against wind damage, nevertheless four of them were lost the first year due to a wind storm.

During the spring of 1960 several numbers bloomed but only one carried fruit to maturity, and it carried twelve fruits, four years from seed. This was the one designated Edward x Pico No. 18. The fruit was of very good quality and the tree fruited well during the next two years. It later was named 'Duncan' in honor of Ralph V. Duncan of Boynton. During the Spring of 1961 seventeen others bloomed and set fruit but suffered much loss due to gale winds of April and May. By the summer of 1962 twenty-two numbers had fruited, of these fourteen were discarded and eight were top-grafted on separate stumps for further observation.

Most of these inarched seedlings made vigorous growth and the plot became over crowded. Some of the weaker ones had to be removed to out-lying stocks thereby adding three more years to testing time. In 1963 several others fruited and were discarded with the exception of Edward x Pico No. 15, later named 'WESTER' in honor of the late Peter J. Wester. In 1964 the only number worth keeping for further testing was the Edward x Kent No. 14, later named the 'YOUNG' in honor of Dr. T. W. Young who has done much work with the mango in Florida. In 1965 several others fruited with only one worthy of further testing, this was later named the 'MEKONG' because of its resemblance to the description of Mangifera mekongensis by J. Lan, in Les Plantes Indochinensis de Grande Culture.

The Edward x Springfels numbers were all discarded as undesirable. The fruits were of a good medium size, uniform in shape and with attractive coloring. The fine textured flesh had practically no fiber, in fact everything about them was good except the flavor which ranged from bad to horrible.

The final results of this series stands at three Edward x Pico hybrids and one Edward x Kent. There is no doubt in my mind that they are true hybrids. In view of this initial success the writer has been encouraged to test out a second series of seedlings from the crops of 1965 through 1968.

Of the 27 Edward x Pico seedlings five were definitely polyembryonic, and the fruits were of
the Philippine type. In the earlier days of this testing I did not check for polyembryony among the discarded numbers until Wester appeared in 1963, and by that time about one third of the seedlings had been discarded without checking. Some of these early discarded ones were of the Philippine type of small fruits in clusters.

In assessing the growth and fruiting qualities of these four selected varieties I recognize a resemblance in Mekong and Wester to the Pico in susceptibility to cold weather at time of blooming and fruit setting. I do not feel these two varieties would be suitable for commercial plantings in Florida. Like the variety Edward they may be more successful in homestead plantings in the warmer urban locations, and throughout the West Indies. The Duncan is cold hard and the comparatively short and stout stems tend to reduce fruit loss in strong winds. During these nine years of testing we have had either direct or side winds of six hurricanes. The Young variety is also quite cold hardy and has fruited well each year since 1964. Several other numbers produced fruit of very good quality but the production of fruit was poor so they were discarded.

The Duncan fruit is roundly oval with the dorsal shoulder sloping steeply, the ventral shoulder is rounded. The stout stem is inserted obliquely in a slight depression. The apex is rounded, the nak inconspicuous, about one inch from the apex. The skin is medium thick, smooth and tough, yellow to golden-yellow without blush. The soft flesh is amber in color, firm, of fine texture and fiberless, somewhat between Pico and Edward in flavor. The seed hull is comparatively slender, flat at each end and with short fibers around the edge. The small seed is monoembryonic. Length of fruit averages 4½"-5"; width 3¾"-3½"; thickness 3"-3¾"; weight 18-22 oz. The fruit has matured from late June through late August according to early or late blooming, there are usually two sets of fruit each year. The fruit is carried singly or in clusters of two, three or sometimes four with little difference in size. The tree is unbranched in form of growth with a heavy canopy of foliage.

The Young fruit is roundish with a high dorsal shoulder. The skin is smooth and thick with an orange blush of the exposed side, the background coloring being golden-yellow when ripe. The flesh is pale yellow with a narrow band of darker color just under the skin, of a medium fine texture, fiberless, and of a mild sweet flavor. The skin hull is quite flat with slight fiber on the dorsal edge. The small seed is monoembryonic. The fruiting is generally single, sometimes carrying two fruits to a spike but rarely three. The fruit averages 4½"-5" in length; 4"-4½" in width; 3¾"-3½" in thickness. The seed hull is comparatively small. The initial growth of the tree is strongly upward, spreading out with weight of branchings to form a fairly open top bearing fruit throughout. The canopy is light and open. The Wester fruit is broad and thick throughout the upper part tapering rapidly to a long, rounded tip, the nak is inconspicuous. The slender stem sets deep in a groove with the dorsal shoulder bulging. The skin is smooth, thick and tough, of a golden-yellow color with faint intricate tracings. The flesh is smooth, fiberless, of a fine texture, pale orange in color and of a sweet agreeable flavor quite similar to that of Pico. The seed hull is long and quite flat at each end with short fibers on the dorsal edge. The small seed is thin, round and polyembryonic. Length 5¼"-5½”; width 3¼"-3¾”; thickness 3"-3¾”; weight 18-20 oz. The tree is quite uniform in growth with a light canopy. The fruits are carried singly, in two or three, sometimes four to a spike.

The Mekong fruit is oval, slightly thicker at the shoulder, often a slight depression in the area of the nak which is inconspicuous. The stout stem is inserted at the top of the round, shoulderless upper end, without groove or depression. The fruit length is 6"-7”; width 3½”; thickness 3¾”, and the weight is 16-18 oz. The skin is smooth, medium thick and tough, creamy-yellow with blast on exposed side, with no special markings. The flesh is of a fine texture, pale cream in color, fiberless and of a mild sweet flavor. The seed hull is long and slender, flattened at each end with short fibers along the ventral edge. The flattish seed fills the central part of the hull and is polyembryonic. The fruits are carried singly or in doubles, rarely in threes. The tree has a vigorous sprawly form of growth with long branches shooting out almost horizontally. As the tree becomes older the growth becomes more upright to form an open top.

Among the fruits produced by this series of hybrids none was far out from the normal. In addition to much variation in the size and dens-
ity of bloom spikes there was also much variation in perfume of the flowers, which may have some influence upon insect activity.

Each mango variety has its own distinct color pattern in the juvenile leaves. Those of the East Indian forms lean toward the darker reds while the Indochinese and Philippine forms show lighter blends of reds and yellows. These color blends show in great variation among hybrids and are very interesting in daily change as the young leaves expand and the green blends in. My first experience in the practical use of this color pattern was about thirty years ago when some small budded plants of Paheri and Edward were accidentally mixed in the nursery. During the dormant winter months I could not separate them by physical characteristics. Upon the first flush of new growth in spring they were readily recognized by the color pattern of the young leaves.

The color patterns have been very noticeable this past summer in a group of Haden x Duncan seedlings, with colors running from the ruby red of Haden to the pale amber of Duncan. At present these color patterns seem to offer greater application in work with polyembryonic seedlings. Where a polyembryonic pistil parent is used in breeding the hybrid gametic sprout may be recognized from the self-pollinated gametic sprout, and from the nucellar sprouts.

Colors in the leaves of newly sprouted seedlings are not reliable in identification. The young leaves must mature one flush of growth, with green leaves and stems, with its own roots and independant of the seed. The succeeding flush of new growth will carry the characteristic new leaf color of that individual plant.

Bloom spikes also show a degree of varietal color pattern as they evolve toward fruit setting, reflecting color intensity in the mature fruit.

The second series of hybrids, from the crop years of 1965 through 1968, is now under observation. This series carries a larger number of seedlings from a greater diversity of parentage. In 1962 large trees of assorted varieties were cut back for top-grafting to the new variety Duncan. Hurricanes during the succeeding years of the middle 60's broke off several of the graft branches, their places being taken by adventitious shoots from the original tree. When these adventitious shoots came to bloom their different colors of bloom spike were readily noticeable crowded among the densely surrounding branches of Duncan bloom. Their fruits were harvested and the seeds planted in gallon cans marked with plastic tape. In this series there was a greater degree of isolation with correspondingly greater probability of the desired hybridization.

These two series of hybrids were pollinated under different conditions, as they naturally existed at the time. There were drawbacks to both methods of operation. I now feel that the more flexible method would be to have the pistil parents, of a transportable size, growing in containers, so that they could be taken to wherever there may be a desirable pollen parent. This would eliminate the drawbacks of the other methods.

From working with these mangos, and their seeds, the impression is gained that there may well be variety degrees, or intensities, of polyembryonic influence in the hybrids. The wild types such as No. II, Peach and Turpentine appear to have higher degrees, and the hybrids lesser degrees, as evidenced by the number and strength of growth force of their nucellar sprouts. The question then arises as to the reliability of these varying degrees of polyembryony in breeding, and the influence of these varying degrees on fruiting.

DEGENERATE MANGO OVARIES

THOMAS T. STURROCK

Florida Atlantic University
Boca Raton

One of the well known difficulties with the commercial and private production of mango fruit is the poor or erratic bearing characteristic of this species. Alternate bearing and anthracnose infestation have been discussed by many investigators as factors contributing to this fault (6,8,9). Shortage of perfect blossoms, break-down of the egg apparatus, and embryological defects have been suggested as additional contributing factors to this poor fruit-set